



Variabilities of Long-Lived Species over the Mediterranean Basin: Measurements and Modelling

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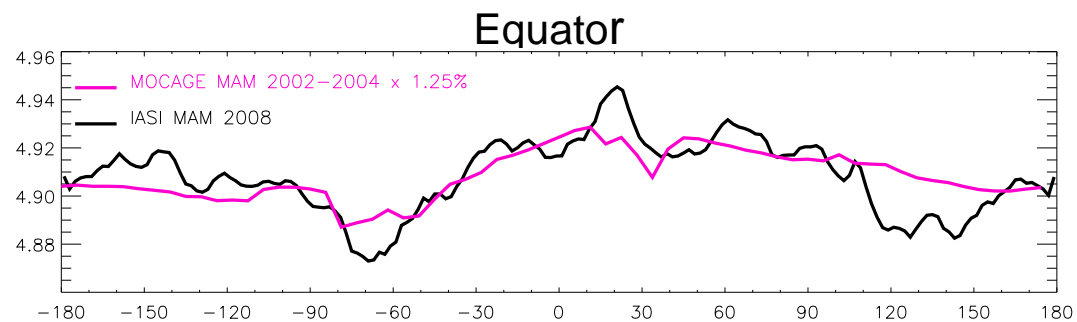
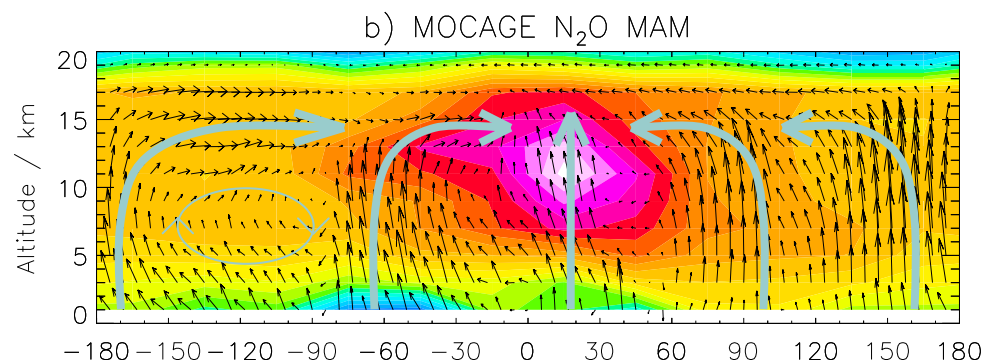
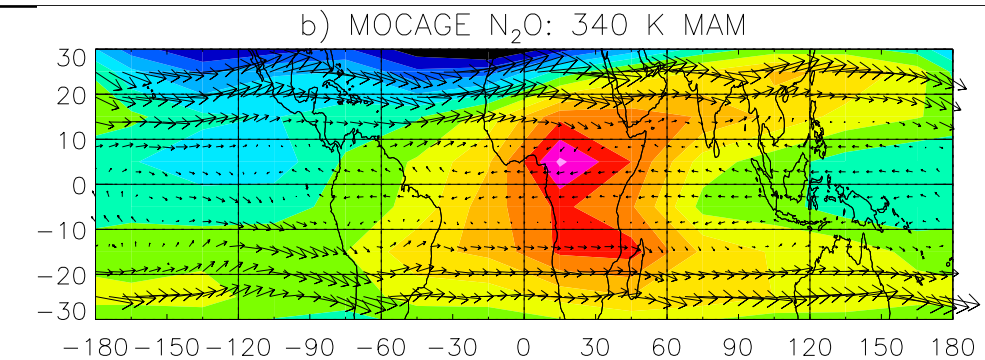
Juying Warner
University of Maryland, Baltimore, USA



Outline

- Long-lived species such as N_2O help characterizing transport processes in the stratosphere, UTLS and troposphere
 - Limb-scanning instrument: ODIN, AURA/MLS
 - Nadir-viewing instrument: IASI
 - 3D CTM: MOCAGE
- Applications to tropical tropospheric studies
- → Focus on the Mediterranean Basin for the CHARMEX Programme
 - Seasonal Variability
 - East-West Differences
 - Recent trends: 2008-2010

N₂O Variability along the Equator





ChArMEx

Chantier Méditerranée

The **C**hemistry-**A**erosol **M**editerranean **E**xperiment: Update on the project

ChArMEx is the atmospheric chemistry component of a large multidisciplinary Mediterranean regional programme proposed by France

WP Sources

WP Ageing

WP AQ and Transport

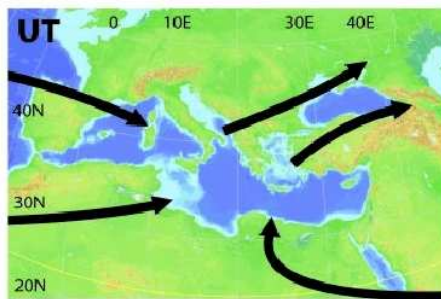
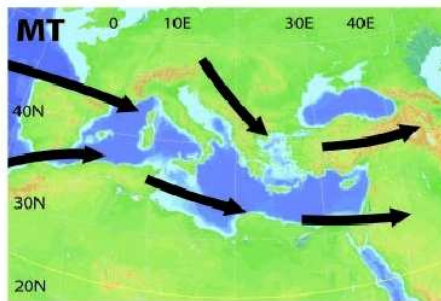
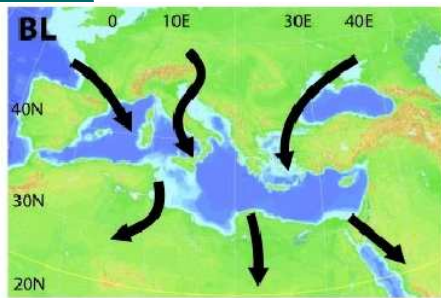
WP Radiation

WP Deposition

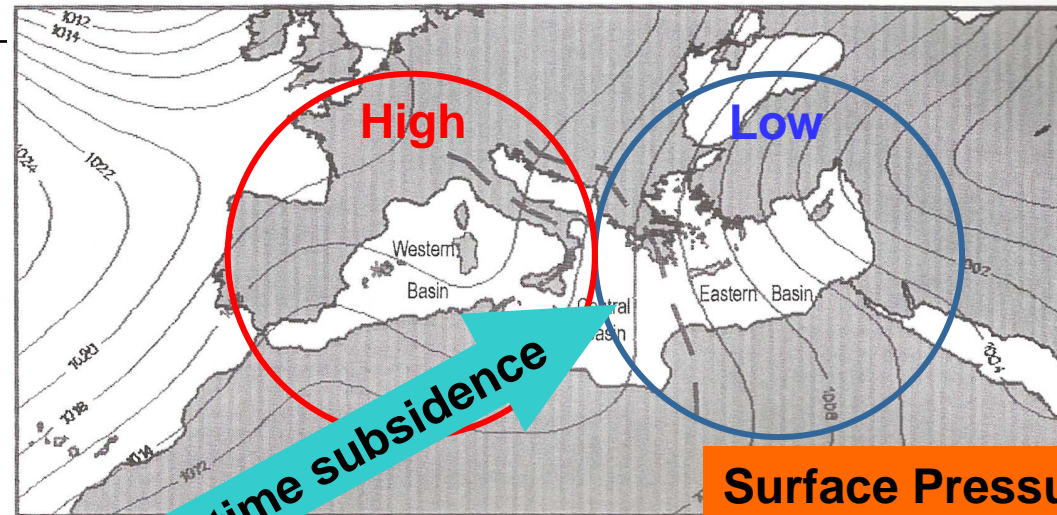
WP Recent Trends and Variabilities

WP Future

Summertime Transport Processes over the Mediterranean Basin

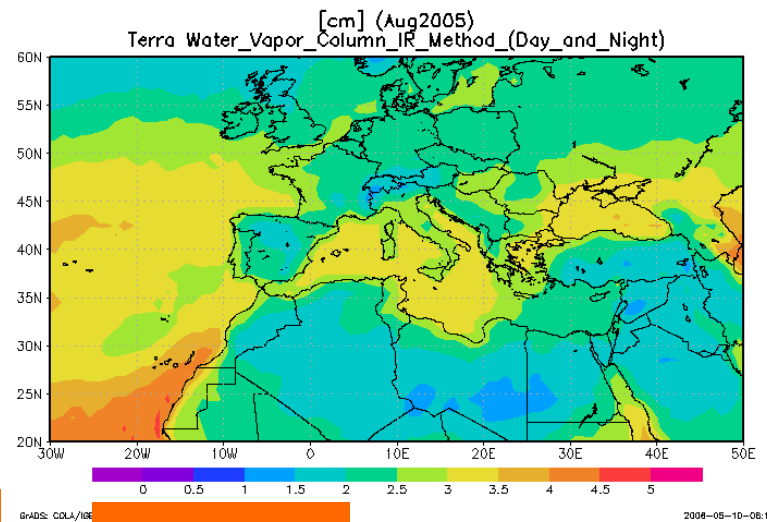


Lelieveld et al. (2002)

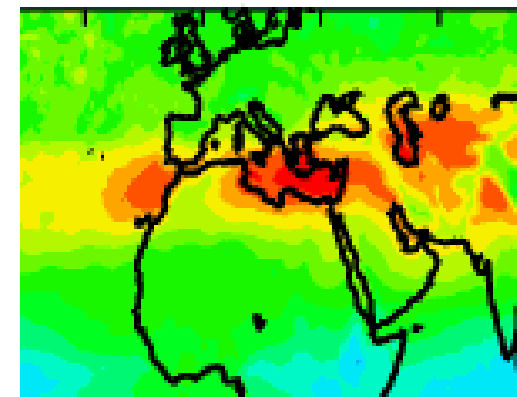


Daytime subsidence

Surface Pressure
(Millan et al., 1997)



Total H₂O



Tropospheric O₃
column from OMI/MLS

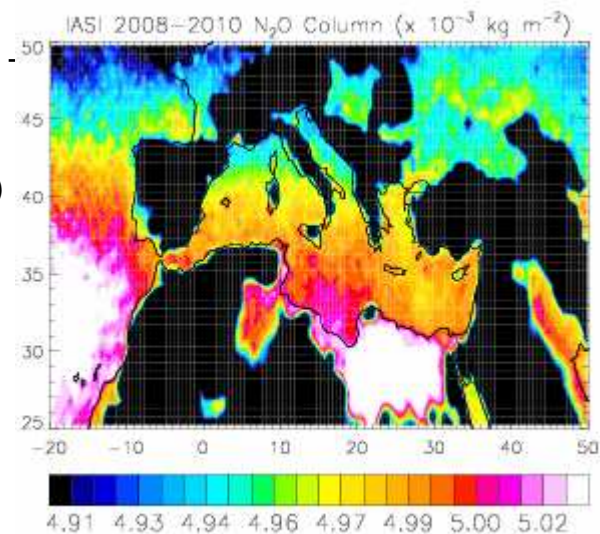


Data Sets

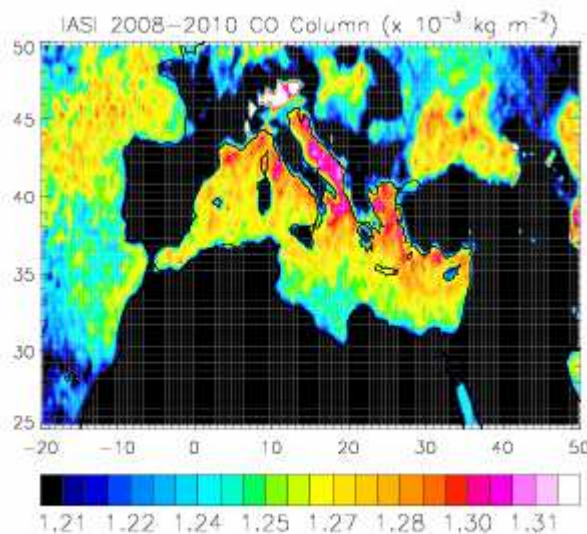
- Nadir-viewing Metop/IASI official L2 data provided by EUMETSAT
 - N₂O, CO, CH₄ and CO₂ total columns
 - Neural Network Retrieval
 - 2°x2°
 - February 2008 – June 2010
- Aqua/AIRS
 - CO total columns from Giovanni Web site (L3 data at 1°x1°)
 - Preliminary CH₄: mixing ratio → total columns (Eastern MB)
 - June 2008 – June 2010
- 3D CTM MOCAGE (N₂O, CO and CH₄ Total Columns)
 - 2°x2°, ~200 chemical species
 - Constrained by Météo-France/Arpege Analysis
 - Surface emissions (F. Dentener (JRC) → 4th IPCC Report)
 - CH₄: monthly & diurnally constant
 - N₂O: monthly constant but diurnally varying
 - CO: monthly and diurnally varying
 - January 2008 – June 2010

IASI Total Columns: 2008-2010

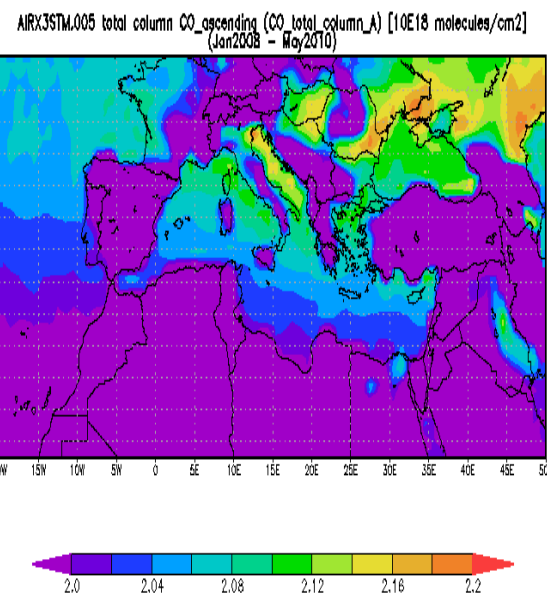
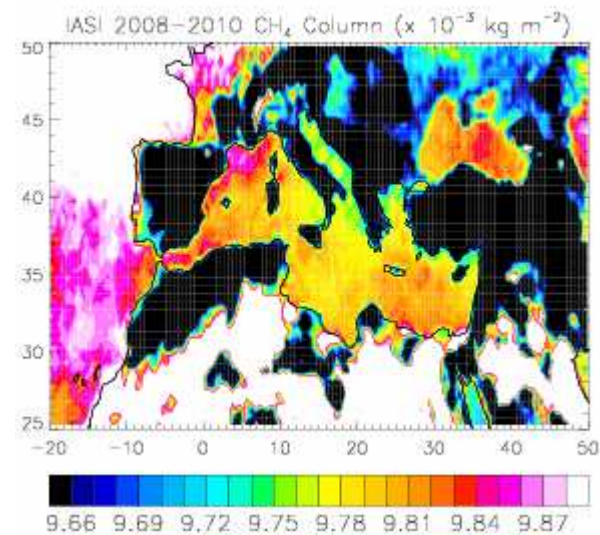
N_2O



CO

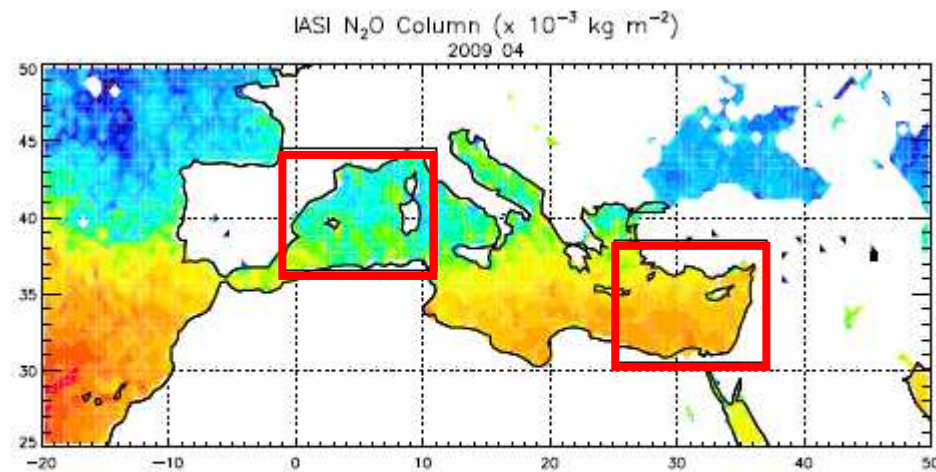


CH_4

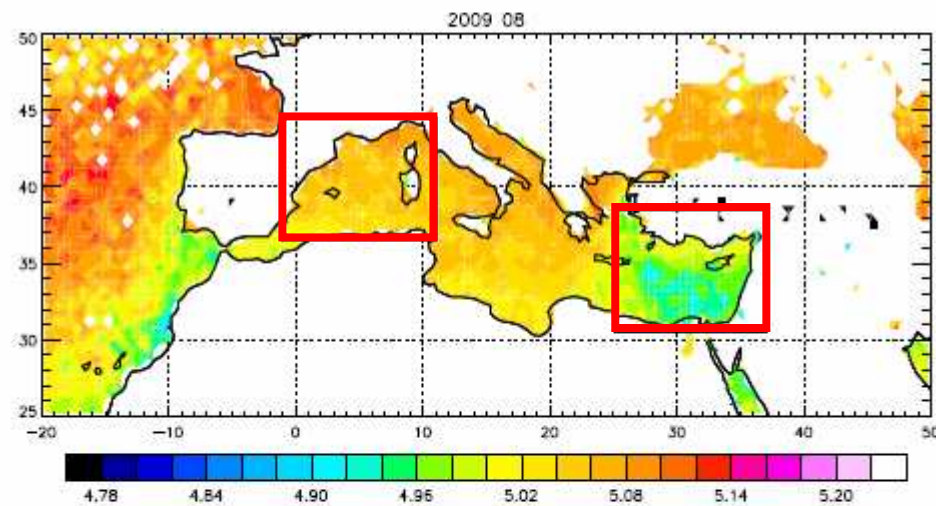


AIRS CO (V5)

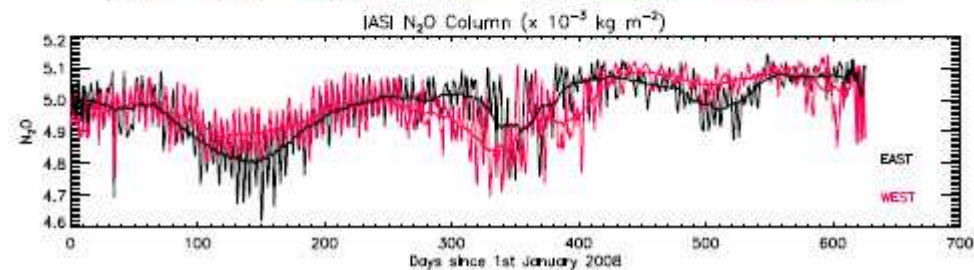
IASI Maritime N₂O Total Columns



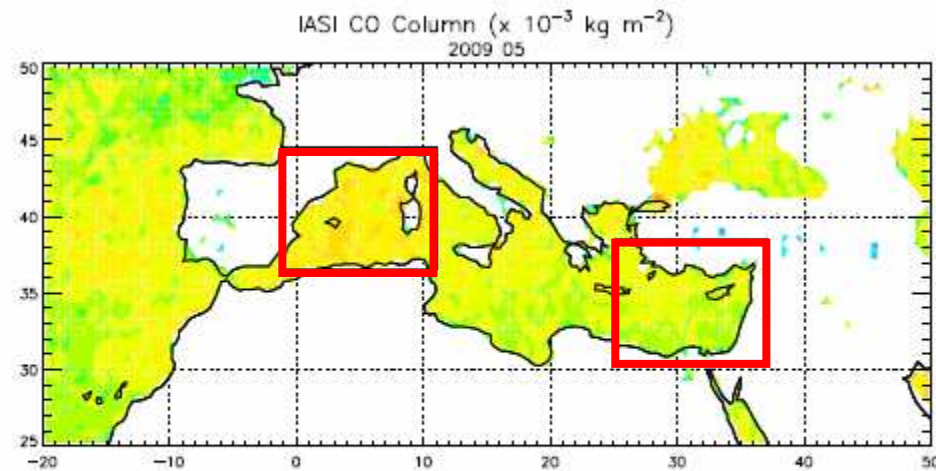
April 2009



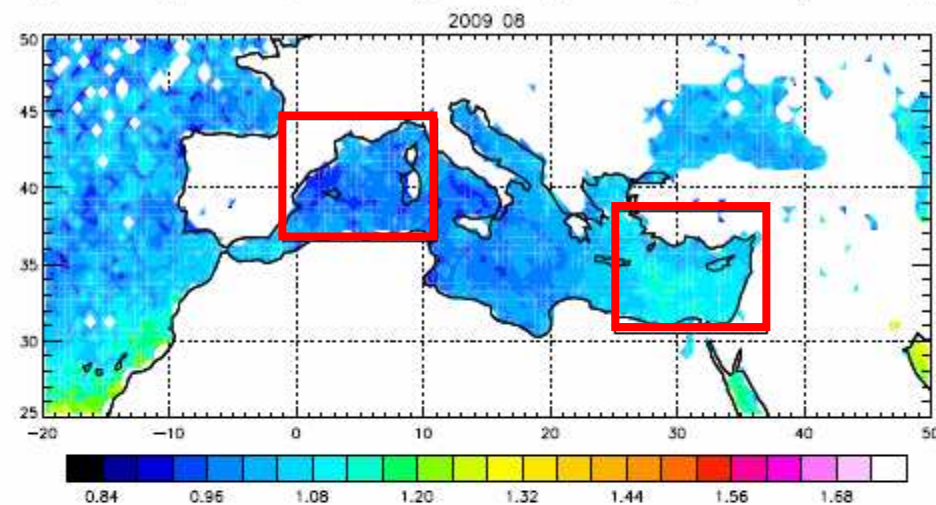
August 2009



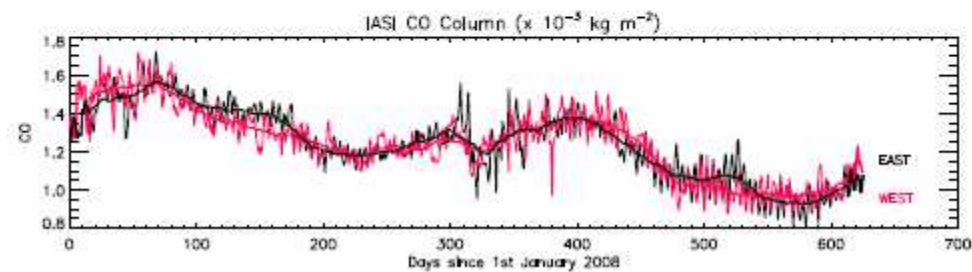
IASI Maritime CO Total Columns



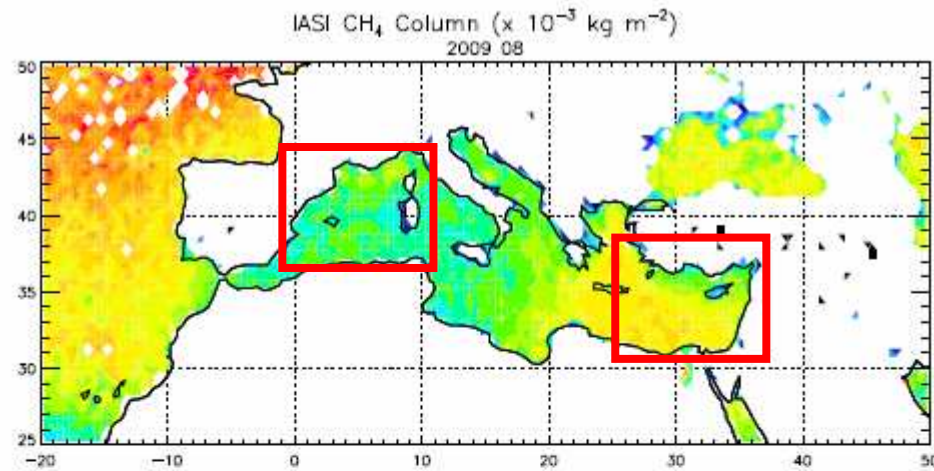
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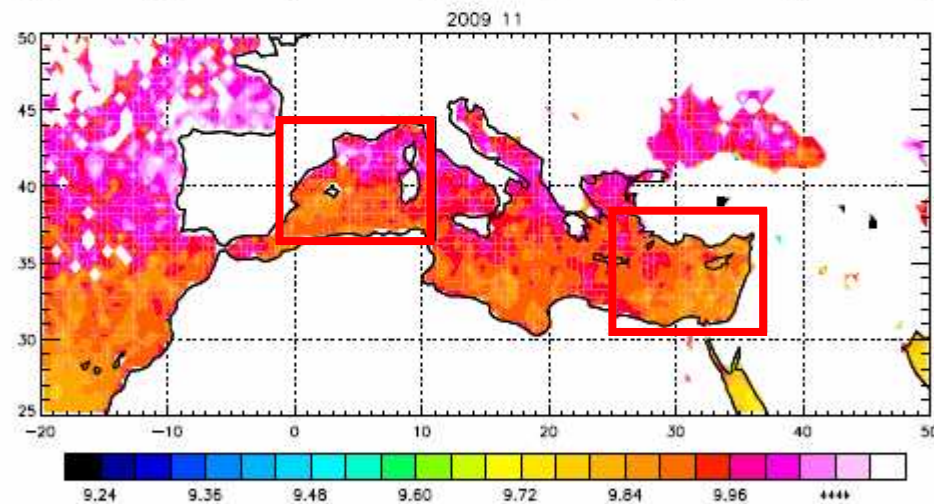
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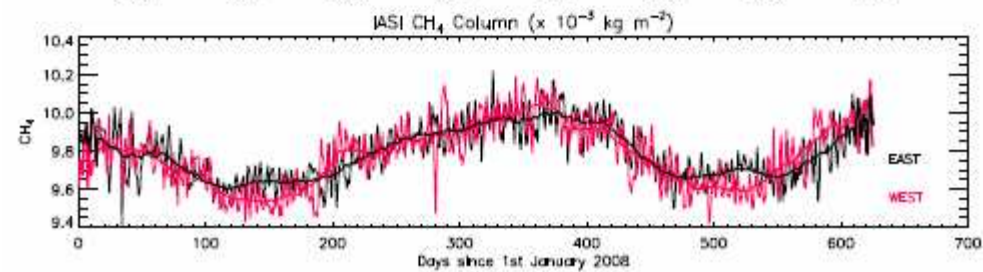
IASI Maritime CH₄ Total Columns



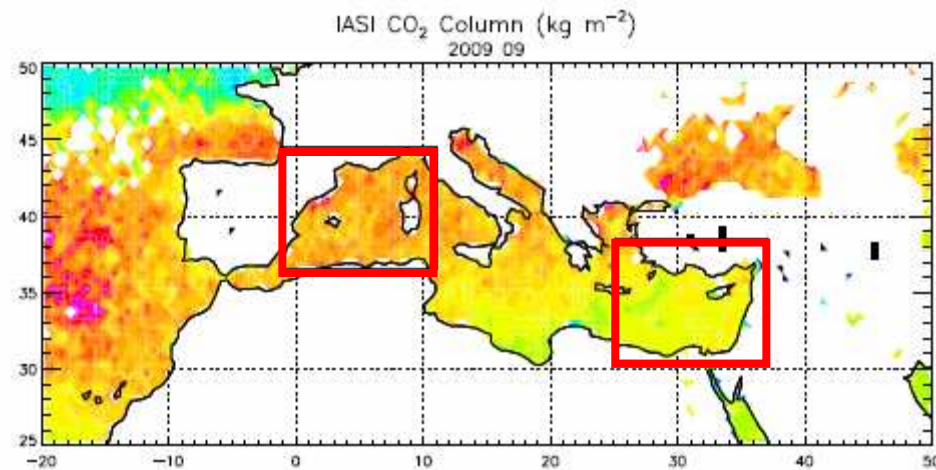
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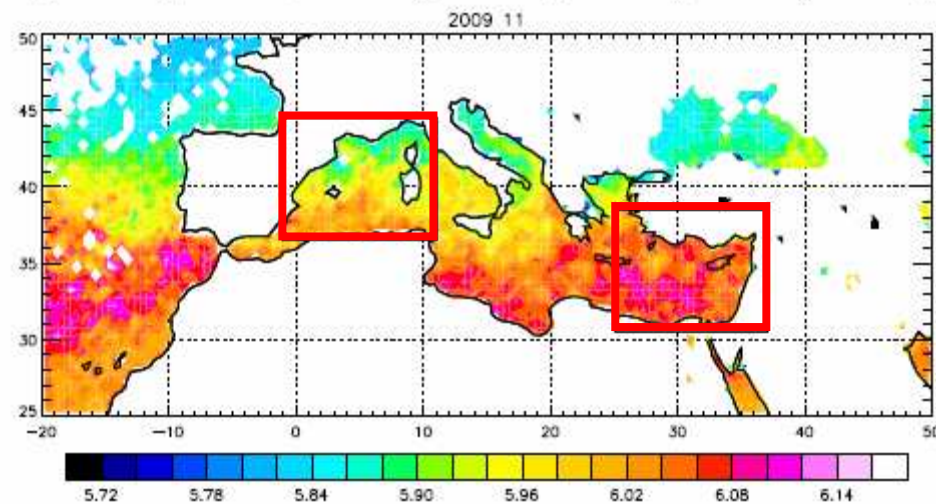
November 2009



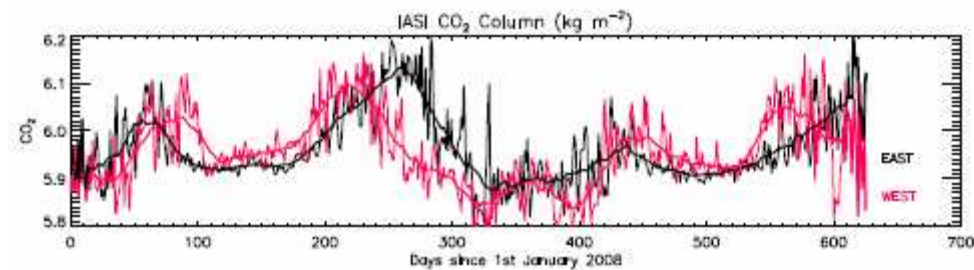
IASI Maritime CO₂ Total Columns



September 2009

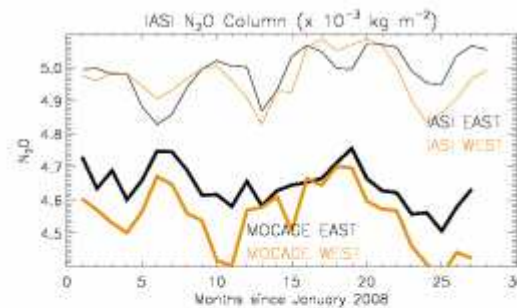


November 2009

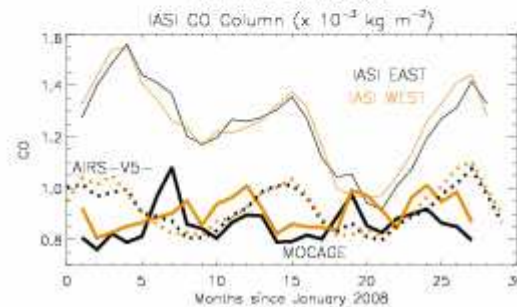


East vs. West MB Time Evolutions: January 2008 – June 2010

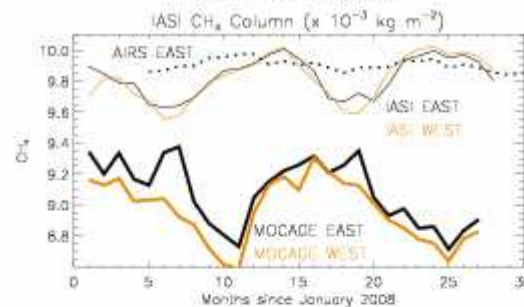
N_2O



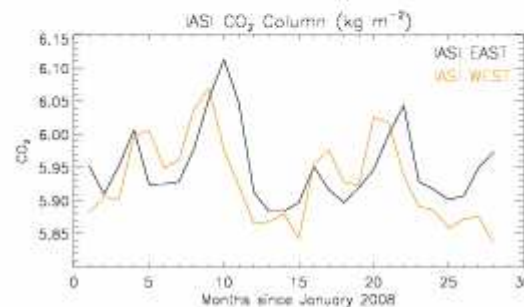
CO



CH_4



CO_2



Jan 2008

June 2010

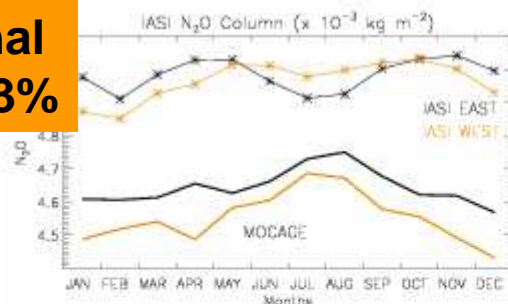
2008-2010

Seasonal Variations

East-West Seasonal Variations

IASI seasonal
amplitude: 3%

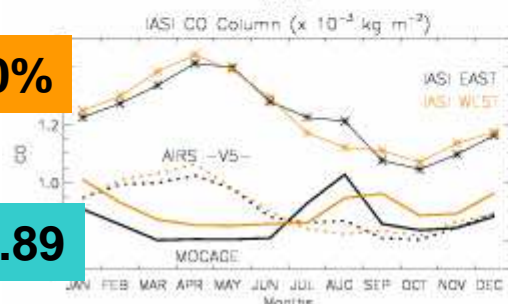
N_2O



CO

20%

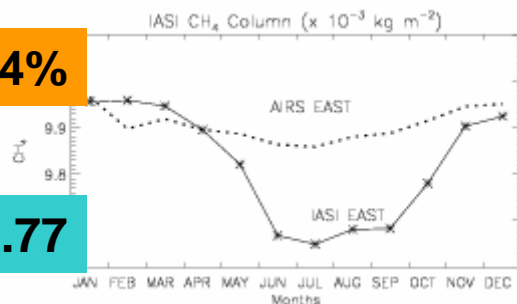
$r_{IASI-AIRS} = 0.89$



CH_4

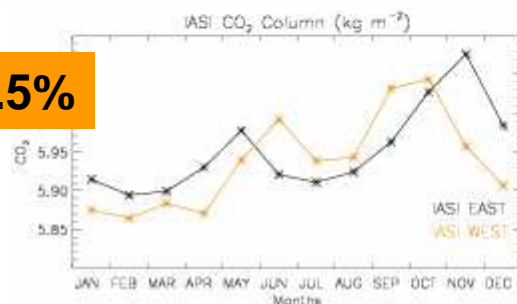
4%

$r_{IASI-AIRS} = 0.77$



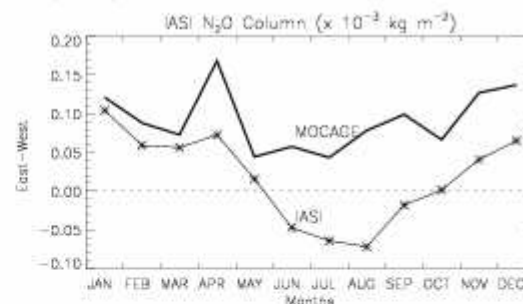
CO_2

2.5%

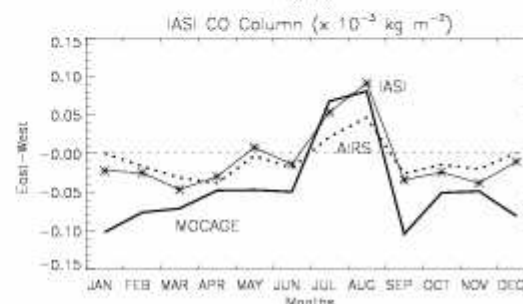


Jan

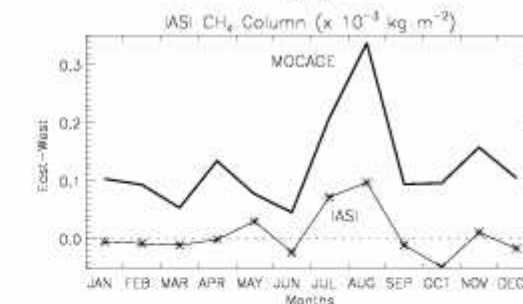
Dec Jan



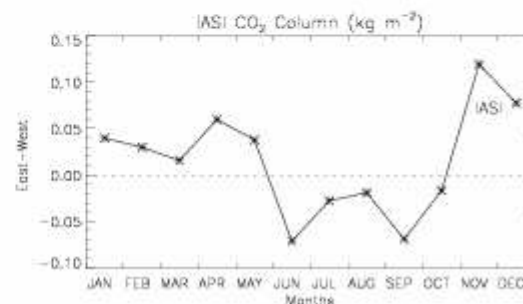
IASI East-West
Difference: 3%



10%



1%



2.5%

Dec



Synthesis

- IASI Total Columns of N₂O, CO, CH₄ and CO₂ provided by EUMETSAT in 2008-2010 and AIRS Total columns of CO -V5- (and preliminary CH₄ total columns)
- East-West marked differences whatever the species considered over the maritime MB depending on seasons
- Seasonal variability
 - N₂O and CO₂ in phase (semi-annual oscillation; East-West difference centered in summer with West>East)
 - CO and CH₄ in phase (annual oscillation; East-West difference peaking in summertime with East>West)
 - Consistencies between AIRS and IASI CO variabilities and East-West differences ($r \sim 0.9$)
 - (preliminary) Consistencies between AIRS and IASI CH₄ variabilities in the Eastern MB ($r \sim 0.8$)
- MOCAGE CTM
 - Tracks the measured AO with 6-month time lag but no SAO
 - Shows East-West contrasts (greater than measured for CO and CH₄ and conversely for N₂O)



Further study

- CH₄ and CO₂ total columns from AIRS (+N₂O), TES (+ N₂O) and GOSAT
 - CO₂ to be included in MOCAGE
 - Monthly surface emission inventory for N₂O and CH₄ in MOCAGE
 - Meteorological parameters (surface and mid-troposphere temperature & pressure, vertical velocity, etc.)
-
- Acknowledgements
 - CNRS via LEFE/INSU
 - CNES
 - Ether data base
 - EUMETSAT
 - AIRS data via Giovanni online visualization and analysis
 - University of Maryland